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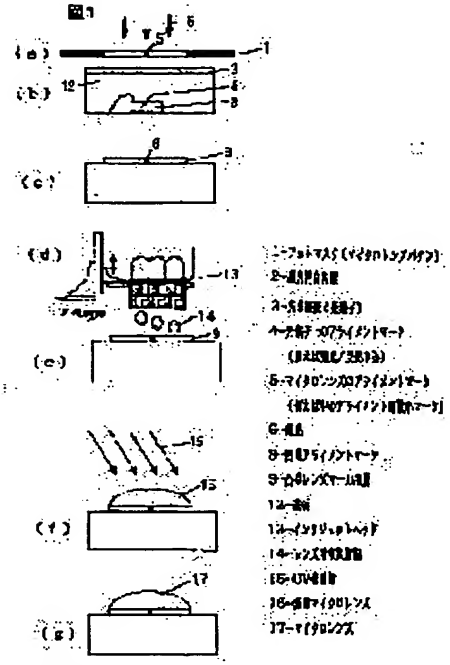
(54) MICROLENS FORMING METHOD

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a microlens forming method capable of simply performing the alignment of the optical axis of an optical device (an optical element, an optical part or the like) with that of a microlens at a low cost.
SOLUTION: A photomask (1) having a microlens pattern for forming the microlens and an alignment mark pattern is used, and the alignment mark (5) of the microlens is aligned with the alignment mark (4) of the optical element by setting the alignment mark of the optical device having the optical element (3) to the light emitting or receiving center of the optical element to align the optical axis of the microlens with that of the optical device. A film (9) for a lens marker, to which the microlens pattern having an alignment mark (8) at the center thereof is transferred, is formed on a substrate (12), and a liquid resin for the microlens is injected on the film for the lens marker to form a liquid microlens which is, in turn, irradiated with UV rays to be cured to form the microlens.



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* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] The micro-lens pattern which is the approach of forming a micro lens in the above-mentioned substrate front face of the optical equipment which a lightwave signal outputs and inputs to a light corpuscle child through the substrate which lightwave signal light penetrates, and specifies the part which forms the above-mentioned micro lens, The photo mask which has the alignment mark pattern formed in the interior of this pattern is used. The alignment mark which set the alignment mark of optical equipment as the above-mentioned light corpuscle child's luminescence or light-receiving core, or was independently formed on the light corpuscle child is prepared. On the other hand, the alignment mark of the above-mentioned photo mask, By carrying out alignment of the alignment mark of the above-mentioned optical equipment The process which forms the above-mentioned micro-lens ingredient and the photosensitive ingredient film with an equal refractive index on the substrate which doubles the location of the above-mentioned optical equipment with the above-mentioned photo mask, and forms the above-mentioned micro lens, By using the above-mentioned photo mask on the above-mentioned photosensitive ingredient film, and exposing and developing negatives The process which forms in a core the film for lens markers which imprinted the micro-lens pattern which has an alignment mark, The liquefied resin for lenses is injected on the micro-lens pattern of the above-mentioned film for lens markers. The micro-lens formation approach characterized by including at least the process which forms a liquefied micro lens, and the process which irradiates UV light, is made to harden the liquid micro lens of the above, and forms a micro lens.
[Claim 2] The micro-lens pattern which is the approach of forming a micro lens in the above-mentioned substrate front face of the optical equipment which a lightwave signal outputs and inputs to a light corpuscle child through the substrate which lightwave signal light penetrates, and specifies the part which forms the above-mentioned micro lens, The photo mask which has the alignment mark pattern formed in the interior of this pattern is used. The alignment mark which set the alignment mark of optical equipment as the above-mentioned light corpuscle child's luminescence or light-receiving core, or was independently formed on the light corpuscle child is prepared. On the other hand, the alignment mark of the above-mentioned photo mask, By carrying out alignment of the alignment mark of the above-mentioned optical equipment The process which forms the photosensitive ingredient film on the substrate which doubles the location of the above-mentioned optical equipment with the above-mentioned photo mask, and forms the above-mentioned micro lens, The micro-lens pattern which specifies the part which uses the above-mentioned photo mask for the photosensitive ingredient film formed on the above-mentioned substrate, and forms the above-mentioned micro lens, The process which imprints the alignment mark pattern formed in the interior of this pattern, The process which forms the film for lens markers which left the part which carries out fault development of the above-mentioned photosensitive ingredient film, eliminates the above-mentioned alignment mark imprinted by this photosensitive ingredient film, and forms the above-mentioned micro lens, The liquefied resin for lenses is injected into the part which forms the above-mentioned micro lens. The micro-lens formation approach characterized by including at least the process which forms a liquefied micro lens, and the process which irradiates UV light, is made to harden the liquid micro lens of the above, and forms a micro lens.
[Claim 3] It is the micro-lens formation approach characterize by to consist of an ingredient which carries out the fault development of the above-mentioned photosensitive ingredient film , eliminates an alignment mark in claim 2 , the film for lens markers which left the part which forms a micro lens approaches the part which forms the above-mentioned micro lens on the above-mentioned substrate front face , and is form in the field of the outside of the part which forms this micro lens , and has absorptivity to the wavelength of the above-mentioned lightwave-signal light .

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the micro-lens manufacturing technology of optical equipment.

[0002]

[Description of the Prior Art] Drawing 6 shows an example of the conventional micro-lens manufacture approach indicated by JP,2000-180605,A (Japanese Patent Application No. No. 358956 [ten to]). this conventional approach should boil liquefied ultraviolet-rays (UV light) hardening resin ink jet head 13 — it injects on a substrate 12 as Li and liquefied resin 14 for lenses, the place made to spheroidize with surface tension is stiffened by UV light exposure 15, and a micro lens 21 is formed. The injection capacity of liquefied ultraviolet-rays (UV light) hardening resin can be correctly controlled using a piezo driver element etc., and it is possible to produce the high micro-lens array of repeatability and a controllability. Moreover, since a lens can be direct formed on the substrate 12 of arbitration, it is easy to unite a micro lens with optical components, such as semiconductor laser, and a photo detector, optical waveguide. The dropped liquefied resin depends on the relation of the surface tension of liquefied resin and a substrate for a substrate and the angle to make, i.e., a contact angle, greatly. Although the relation of the surface tension of liquefied resin and a substrate is determined by the viscosity of resin, each temperature of resin and a substrate, the shape of surface type of a substrate, etc., since a contact angle will be uniquely determined if those conditions are the same, applying as the manufacture approach of a micro lens is possible. As a parameter showing the lens property of a micro lens, a focal distance, the F number, a lens diameter (diameter of opening), etc. are mentioned. In these lens parameters, the F number can be easily drawn from the contact angle of resin, and the refractive index of resin. That is, if the combination of the resin (a refractive index is known) which forms a predetermined contact angle, and a substrate is prepared, a micro lens with the desired F number is producible. Moreover, about a lens diameter, a contact angle is not based on injection capacity, but since it is fixed, it is controllable only by injection capacity.

[0003] In the above-mentioned conventional technique, it is possible to produce a micro lens with various lens properties simple. However, although this conventional technique is a method which produces one micro lens at a time and it is also possible to produce a micro-lens array collectively by forming an ink jet head into a multi-nozzle, it depends for the alignment precision of a target location and a injection head on the resolution of the stage drive precision of equipment, and an observation system etc. greatly. That is, in order to raise the formation location accuracy of a micro lens, it is necessary to achieve highly precise-ization of equipment. Highly precise-ization of equipment means expensive rank-ization of equipment, and makes the manufacturing cost of a micro lens increased. Therefore, in order to manufacture a micro lens by low cost, it is necessary for the formation location accuracy of a micro lens to consider as the manufacture approach which is not influenced by equipment precision.

[0004] An example of the manufacture approach of a micro lens that the formation location accuracy of the above-mentioned micro lens was proposed by drawing 7 as the manufacture approach which is not influenced for equipment precision is shown [for example, JP,62-83337,A (Japanese Patent Application No. No. 220375 [60 to])]. This is the approach of forming the disc-like transparence resin (it being hereafter called the film for convex type lens markers) 24 which becomes exposure 6 and the part which should develop negatives and should form the micro lens on a substrate 12 by patterning from a photopolymer 23 using a photo mask 22 about the photopolymer 23 prepared on the substrate 12. Since the disc-like transparence resin 24 which is this convex type lens marker is produced by the photolithography technique using the above-mentioned photo mask 22 which has a micro-lens pattern, both the configuration of the film 24 for convex type lens markers, the accuracy of an array pitch, and its repeatability are high.

[0005] Since the shot position of the drop of liquefied UV photo-curing resin 25 should just be on the above-

mentioned film 24 for convex type lens markers when such film 24 for convex type lens markers is formed on the target substrate, location precision is eased sharply. Although the drop injected on the film 24 for convex type lens markers gets wet and spreads the film 24 top for convex type lens markers, breadth stops at the periphery section and the shape of a globular form is formed naturally. Since the film 24 for convex type lens markers is circular, in accordance with a lens marker's core and accuracy, the diameter of a micro lens 26 is further held correctly for a lens core by the path of the film 24 for convex type lens markers.

[0006] Here, alignment of a photo mask 22 is usually performed using the alignment mark formed in the mask. Although formed in parts other than the micro-lens pattern of a mask, alignment of this alignment mark is carried out as an alignment mark in which this was prepared in the evening-get side. Although it is the detailed pattern formed in the wiring layer as an alignment mark pattern prepared in a target side in many cases, an alignment mark pattern may be produced on optical components (it is collectively called optical components), such as chips, such as a light corpuscle child, and optical waveguide.

[0007] If loading precision of optical components is not raised when the alignment mark is formed on the wiring layer in which optical components were carried, the optical axis of optical components and a micro lens will shift. Therefore, in order to set an optical axis, the mounting technology of highly precise optical components will be needed, and the increment in mounting cost will be caused. Moreover, when forming an alignment mark in optical components, in order to make it in agreement with the alignment mark by the side of a photo mask 22, the size of optical components must be larger than the size of a micro lens enough. Although an alignment mark can also be prepared in a micro lens, it is not desirable to form a mark pattern in a light transmission part, in order to bring about the effect of reflection, dispersion, attenuation, etc. to the transmitted light.

[0008]

[Problem(s) to be Solved by the Invention] In the manufacture approach of the conventional micro lens mentioned above, in order to be dependent on equipment precision and to form a highly precise micro lens, the location accuracy which trickles ultraviolet-rays hardening resin had to attain highly precise-ization of equipment, and had caused a raise in the cost of equipment, as a result the manufacture increase in cost of a micro lens. Moreover, although the technique of forming the disc-like lens marker on the evening-get substrate beforehand was proposed in order to ease the precision of the dropping location of liquefied resin, some technical problems occurred about formation of an alignment mark with a lens marker and optical components (optical equipment). For example, when the expensive loading equipment for carrying optical components correctly was required, were having to form an alignment mark in the front face of optical components, it was required for optical components to be larger than a micro lens in order to form an alignment mark or the alignment mark was prepared in the micro lens, the light transmission property was affected and there was a problem of the lens effectiveness deteriorating.

[0009] The purpose of this invention is to solve the problem of the above-mentioned conventional technique and offer the micro-lens formation approach which can carry out alignment of the optical-axis doubling of optical equipments (a light corpuscle child, optical components, etc.) and a micro lens by low cost simply.

[0010]

[Means for Solving the Problem] In order to attain the above-mentioned purpose, this invention is considered as a configuration like a publication at a claim. namely, the optical equipment (a light corpuscle child —) which a lightwave signal outputs and inputs to a light corpuscle child through the substrate which lightwave signal light penetrates The micro-lens pattern which is the approach of forming a micro lens in the above-mentioned substrate front faces, such as optical components, and specifies the part which forms the above-mentioned micro lens, The photo mask which has the alignment mark pattern formed in the interior of this pattern is used. The alignment mark which set the alignment mark of optical equipment as the above-mentioned light corpuscle child's luminescence or light-receiving core, or was independently formed on the light corpuscle child is prepared. On the other hand, the alignment mark of the above-mentioned photo mask, By carrying out alignment of the alignment mark of the above-mentioned optical equipment The process which forms the above-mentioned micro-lens ingredient and the photosensitive ingredient film with an equal refractive index on the substrate which doubles the location of the above-mentioned optical equipment with the above-mentioned photo mask, and forms the above-mentioned micro lens, By using the above-mentioned photo mask on the above-mentioned photosensitive ingredient film, and exposing and developing negatives The process which forms in a core the film for lens markers which imprinted the micro-lens pattern which has an alignment mark, The liquefied resin for lenses is injected on the micro-lens pattern of the above-mentioned film for lens markers. It considers as the micro-lens formation approach which includes at least the process which forms a liquefied micro lens, and the process which irradiates UV light, is made to harden the liquid micro lens of the above, and forms a micro lens.

[0011] if a micro lens is produced at such a process according to claim 1, optical-axis doubling of optical equipments (a light corpuscle child or optical components) and a micro lens will be markedly alike compared with

the former, will become easy, and will become possible [forming a micro lens with a high location precision by low cost].

[0012] Moreover, it is the approach of forming a micro lens in the above-mentioned substrate front face of the optical equipment a lightwave signal outputs and inputs to a light corpuscle child like through the substrate according to claim 2 which lightwave signal light penetrates. The micro-lens pattern which specifies the part which forms the above-mentioned micro lens, The photo mask which has the alignment mark pattern formed in the interior of this pattern is used. The alignment mark which set the alignment mark of optical equipment as the above-mentioned light corpuscle child's luminescence or light-receiving core, or was independently formed on the light corpuscle child is prepared. On the other hand, the alignment mark of the above-mentioned photo mask, By carrying out alignment of the alignment mark of the above-mentioned optical equipment The process which forms the photosensitive ingredient film on the substrate which doubles the location of the above-mentioned optical equipment with the above-mentioned photo mask, and forms the above-mentioned micro lens, The micro-lens pattern which specifies the part which uses the above-mentioned photo mask for the photosensitive ingredient film formed on the above-mentioned substrate, and forms the above-mentioned micro lens, The process which imprints the alignment mark pattern formed in the interior of this pattern, The process which forms the film for lens markers which left the part which carries out fault development of the above-mentioned photosensitive ingredient film, eliminates the above-mentioned alignment mark imprinted by this photosensitive ingredient film, and forms the above-mentioned micro lens, The liquefied resin for lenses is injected into the part which forms the above-mentioned micro lens, and it considers as the micro-lens formation approach which includes at least the process which forms a liquefied micro lens, and the process which irradiates UV light, is made to harden the liquid micro lens of the above, and forms a micro lens.

[0013] Thus, it is effective in it becoming unnecessary to adjust the refractive index of the resin ingredient of a lens marker and a micro lens, and the width of face of selection of the resin ingredient for micro lenses becoming large by performing fault development according to claim 2, eliminating an alignment mark, and using the process which leaves the part which forms a micro lens.

[0014] Moreover, the film for lens markers which left the part according to claim 3 which carries out fault development of the above-mentioned photosensitive ingredient film, eliminates an alignment mark in claim 2 like, and forms a micro lens It considers as the micro-lens formation approach which consists of an ingredient which approaches the part which forms the above-mentioned micro lens on the above-mentioned substrate front face, and is formed in the field of the outside of the part which forms this micro lens, and has absorptivity to the wavelength of the above-mentioned lightwave signal light.

[0015] By considering as the micro-lens formation approach like above-mentioned claim 3, the resin ingredient for lens markers does not need to be transparent to operating wavelength, and when the light corpuscle child is stationed in the shape of an array, it is effective in the ability to reduce the optical cross talk between adjacent channels by using the ingredient which it dared have colored.

[0016]

[Embodiment of the Invention] <Gestalt 1 of operation> The gestalt of operation of the 1st of this invention is shown in drawing 1 . In drawing 1 , the manufacture approach of a micro lens is the approach of forming a micro lens in the front face of the above-mentioned substrate 12 in the optical equipment outputted and inputted to the light corpuscle child 3 by whom die bond was done through the substrate 12 which lightwave signal light penetrates.

[0017] The micro-lens pattern which specifies the part which forms a micro lens, The photo mask 1 [drawing 1 (a)] which has the alignment mark pattern (minute mark for main alignment) 5 formed in the interior of this pattern is used. The alignment mark 4 on the above-mentioned light corpuscle child 3 (a light corpuscle child's luminescence or light-receiving core), By carrying out alignment of the alignment mark 5 of the above-mentioned photo mask 1, the location of optical equipment 3 is doubled with a photo mask 1, and optical-axis doubling of optical equipment 3 and a micro lens is performed [drawing 1 (b)]. After forming a micro-lens ingredient and the photosensitive ingredient film 2 with an equal refractive index on the substrate 12 which forms a micro lens and exposing the above-mentioned photosensitive ingredient film 2 using a photo mask 1, the film 9 for convex type lens markers (film for lens markers which imprinted the micro-lens pattern) which has the concave alignment mark 8 is formed in a core by developing negatives [drawing 1 (c)]. On the micro-lens pattern of the film 9 for lens markers, the ink jet head 13 [drawing 1 (d)] is used, [drawing 1 (e)] and the liquefied micro lens 16 are formed, UV light exposure 15 is taken [the liquefied resin 14 for lenses is carried out injection/regurgitation,], the micro lens 16 of the shape of this liquid is stiffened, and [drawing 1 (f)] and a micro lens 17 [drawing 1 (g)] are formed.

[0018] Since the photosensitive ingredient film 2 of the negative mold which the exposed part hardens is used for the micro-lens pattern (it is henceforth called the film for lens markers) which specifies the part which forms

a micro lens 17, the alignment mark which carried out forms, such as a cross joint or discoid, is formed in the core. Since this alignment mark is a protection-from-light part, the existing concave alignment mark 8 corresponding to an alignment mark pattern to dent (hollow) is formed in the core of the film 9 for convex type lens markers. However, the part of the depression of this concave alignment mark 8 is closed by the process of injection/regurgitation of the drop of the liquefied resin 14 for lenses performed continuously, serves as the completely same solid phase as the film 9 for convex type lens markers, and can form a homogeneous micro lens. Here, when the refractive index of the film for convex type lens markers and the resin ingredient for micro lenses was adjusted, optically, the interface was not able to become but the depression between the film 9 for lens markers and the concave alignment mark 8 was able to obtain the homogeneous and transparent micro lens.

[0019] <Gestalt 2 of operation> The gestalt of operation of the 2nd of this invention is shown in drawing 2 . In drawing 2 , a lens marker is formed using the photopolymer of the positive type from which the exposed part is removed. By using the photopolymer of a positive type, the film 10 for lens markers (film for concave lens markers) of the configuration (it became depressed) where the micro-lens part was dented is formed on the contrary [the gestalt 1 of the above-mentioned implementation]. The micro-lens pattern which specifies the part which forms a micro lens, The photo mask 1 [drawing 2 (a)] which has the alignment mark pattern 5 formed in the interior of this pattern is used. By setting the light corpuscle child's 3 alignment mark pattern as the light corpuscle child's (optical equipment) 3 luminescence or light-receiving core, and carrying out alignment of the alignment mark pattern 5 of a photo mask 1 The location of optical equipment 3 is doubled with a photo mask 1, and the substrate 12 in which photosensitive ingredient film 2' of a positive type was formed is carried out exposure 6 using the photo mask 1 which has the above-mentioned micro-lens pattern [drawing 2 (b)]. Negatives are developed and the film 10 for concave lens markers which has the convex type alignment mark 7 is formed in the interior [drawing 2 (c)]. The process [drawing 2 (g)] which injects the liquefied resin 14 for lenses [drawing 2 (e)], forms liquefied micro-lens 16, carries out UV light exposure 15 [drawing 2 (f)] hereafter using the ink jet beef fat 13 [drawing 2 (d)], and forms a micro lens 17 is the same as the gestalt 1 of the above-mentioned implementation almost.

[0020] The alignment mark is formed in the core of a micro lens in order to double the location of a micro lens with a light corpuscle child's luminescence/light-receiving core like [the gestalt 2 smell of this operation] the gestalt 1 of above-mentioned operation. In a development process, as shown in drawing 2 , this alignment mark turns into the minute convex type alignment mark 7, in order to remain without being etched. However, since minute heights are covered with the injection process of the liquid resin performed continuously, these minute heights serve as transparence optically like the gestalt 1 of the above-mentioned implementation according to it by adjusting the refractive index of the resin ingredient for lens markers, and the resin ingredient for micro lenses. In addition, as for **, it is desirable on the film for concave lens markers to use a water-repellent high ingredient as a resin ingredient for lens markers.

[0021] <Gestalt 3 of operation> With the gestalt 3 of this operation, as shown in drawing 3 R> 3, it is not necessary to remove the convex type alignment mark 7 which was formed in the interior of the film 10 for concave lens markers in the case of drawing 2 , and to adjust the refractive index of the film for concave lens markers, and the resin ingredient of a micro lens, and the formation approach of the micro lens which can make large selection width of face of the resin ingredient for micro lenses is stated.

[0022] As shown in drawing 3 (c), the substrate 12 in which photosensitive ingredient film 2' of a positive type was formed is used. By carrying out alignment of the alignment mark pattern 5 of a photo mask 1, and the alignment mark pattern 4 on the light corpuscle child 3 (luminescence/light-receiving core) After considering the light corpuscle child's (optical equipment) 3 alignment as a photo mask 1, fault development is performed in the process which carries out exposure 6 and is developed. The convex type alignment mark 7 imprinted by photosensitive ingredient film 2' of a positive type is removed, and film 10' for concave lens markers which specifies the edge by the side of the periphery of a micro-lens formation part is formed. Next, the process [drawing 3 (g)] which injects the liquefied resin 14 for lenses, forms [drawing 3 (e)] and the liquefied micro lens 16, takes UV light exposure 15, is stiffened and forms [drawing 3 (f)] and micro-lens 17 ** on film 10' for concave lens markers which is the part which forms a micro lens is the same as the gestalten 1-2 of the above-mentioned implementation.

[0023] By considering as such a micro-lens formation approach, it becomes unnecessary to adjust the refractive index of the resin ingredient of a lens marker and a micro lens, and width of face of selection of the resin ingredient for micro lenses can be made large. Moreover, when it does not need to be transparent and the light corpuscle child is stationed in the shape of an array to operating wavelength as a resin ingredient of the film for concave lens markers, the effectiveness of reducing the optical cross talk between adjacent channels can also be expected by using the ingredient which it dared have colored. However, generally, since the photosensitive

ingredient of a positive type (photolysis mold) has few classes, when track records, such as the dependability of resin, have priority, the direction which uses a negative-mold photopolymer is a best policy. In addition, an example of the mask pattern for lens marker production used with the gestalten 1-3 of the above-mentioned implementation was shown in drawing 5 . Although drawing 5 showed the disc-like thing minute as an alignment mark, you may be a cross-joint configuration etc.

[0024] <Gestalt 4 of operation> As shown in drawing 4 , in the gestalt 4 of this operation, by forming the film 11 for ring-like lens markers explains the case where a micro lens is produced, using the photo mask 1 [drawing 4 (a)] which has the ring-like lens marker pattern 19. Although the point which carries out patterning using the photopolymer of a positive type is the same as the gestalt 2 of the above-mentioned implementation, when the resin ingredient for micro lenses is dropped, it differs in that the appearance of a micro lens is determined on the edge of the outside of the film 11 for ring-like lens markers.

[0025] When the resin for micro lenses is dropped, in order to stop the breadth, the device of using a water-repellent ingredient or thickening a lens marker's thickness was required for the film 10 (drawing 2) for concave lens markers. These are factors which make a production process restrict and make it difficult, and it is missing and they have few [a edge] things which resin spreads on the film for lens markers by a dry area etc. By the film 10 (drawing 2) for concave lens markers, and the film 9 (drawing 1) for convex type lens markers, the film 9 for convex type lens markers can form a micro lens with sufficient repeatability. That is, the film 11 for ring-like lens markers shown in the gestalt 4 of this operation has the good point of both sizes of the goodness of the repeatability of micro-lens production which the film 9 for convex type lens markers has, and the alternative of the resin ingredient for micro lenses which the film 10 for concave lens markers has.

[0026] Also in the film 11 for ring-like lens markers, the alignment mark of a micro-lens core is removable like the gestalt 3 of the above-mentioned implementation with fault development. Since fault development also of the ring part is similarly carried out in that case, it needs to be cautious of the design of ring width of face. In addition, in the gestalt of the above-mentioned implementation, although the ink jet method has been taken up to the method which injects liquefied resin, it does not limit to an ink jet method, and if it is the method which can trickle a minute quantity of a drop with a sufficient controllability, it can apply, for example, this can also use a dispenser method. Moreover, in the gestalt of the above-mentioned implementation, although the thing of a single channel has been taken up as a light corpuscle child, this is not limited to a single channel. In the light corpuscle child array arranged a single dimension thru/or in the shape of-dimensional [2], the micro-lens formation approach of above-mentioned this invention is completely applicable similarly.

[0027]

[Effect of the Invention] According to the micro-lens formation approach of having used the property in which the drop of the minute amount of this invention became globular form-like on a substrate In a lens marker's mask pattern used in order to raise the diameter of a micro lens, and the accuracy and repeatability of an array array It becomes possible by forming a minute alignment pattern in the core of a micro lens, and carrying out alignment of this and a light corpuscle child's (optical equipment) luminescence/light-receiving core to set those opticals axis easily. It is not necessary to form a special alignment mark, and to carry a light corpuscle child using the high-class mounting approaches, such as a flip chip, and to newly prepare an alignment mark in a chip front face as a lens marker used in order to be used in order to set the optical axis of a light corpuscle child and a micro lens, and to raise the formation location precision. Furthermore, a chip appearance is small, and since it is settled in the projection size of a micro lens, when an alignment mark cannot be formed, the micro lens whose optical axis suited to the light corpuscle child can be produced by low cost. Moreover, although the lens marker used for the alignment of a micro lens and a light corpuscle child is in a light transmission field, he can remove optically or physically and can prevent the increment in an unnecessary interface.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] Drawing explaining the micro-lens formation approach illustrated with the gestalt 1 of operation of this invention.
[Drawing 2] Drawing explaining the micro-lens formation approach illustrated with the gestalt 2 of operation of this invention.
[Drawing 3] Drawing explaining the micro-lens formation approach illustrated with the gestalt 3 of operation of this invention.
[Drawing 4] Drawing explaining the micro-lens formation approach illustrated with the gestalt 4 of operation of this invention.
[Drawing 5] The top view showing an example of the mask pattern for lens marker production used with the gestalten 1-3 of operation of this invention.
[Drawing 6] The explanatory view showing the manufacture approach of the micro lens using the surface tension of the drop of the conventional minute amount.
[Drawing 7] The explanatory view showing the manufacture approach of a micro lens using the conventional lens marker.
[Description of Notations]
1 — Photo mask (micro-lens pattern)
2 — Photosensitive ingredient film
2' — Photosensitive ingredient film
3 — Optical equipment (light corpuscle child)
4 — Alignment mark on a light corpuscle child (for example, luminescence/light-receiving core)
5 — Alignment mark of a micro lens (for example, minute mark for main alignment)
6 — Exposure
7 — Convex type alignment mark
8 — Concave alignment mark
9 — Film for convex type lens markers
10 — Film for concave lens markers
10' — Film for concave lens markers
11 — Film for ring-like lens markers
12 — Substrate
13 — Ink jet head
14 — Liquefied resin for lenses
15 — UV light exposure
16 — Liquefied micro lens
17 — Micro lens
18 — Mask pattern for lens marker production
19 — Ring-like lens marker pattern
20 — Stage
21 — Micro lens
22 — Photo mask (micro-lens pattern)
23 — Photopolymer
24 — Disc-like transparence resin (film for convex type lens markers)
25 — Liquefied UV photo-curing resin
26 — Micro lens

[Translation done.]